

1966 OPERATING SUMMARY

WATERLOO

water pollution control plant

ONTARIO WATER RESOURCES COMMISSION

Division of Plant Operations

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ONTARIO WATER RESOURCES COMMISSION
OFFICE OF THE GENERAL MANAGER

Members of the Waterloo Local Advisory Committee,
City of Waterloo.

Gentlemen:

We are pleased to submit to you the 1966 Operating Summary for the
Waterloo Water Pollution Control Plant, OWRC Project No. 58-S-22.

It is hoped that our joint participation in efforts to combat water pollution
will have even more success in the coming year.

Yours very truly,

A handwritten signature in dark ink, appearing to read "D. S. Caverly", is written over the typed name.

D. S. Caverly,
General Manager.

LIBRARY COPY

JUN 19 1968

ONTARIO WATER
RESOURCES COMMISSION



ONTARIO WATER RESOURCES COMMISSION

801 BAY STREET

TORONTO 5

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VICE-CHAIRMAN

D. S. CAVERLY
GENERAL MANAGER

W. S. MACDONNELL
COMMISSION SECRETARY

General Manager,
Ontario Water Resources Commission.

Dear Sir:

I am happy to present you with the 1966 Operating Summary for the Waterloo Water Pollution Control Plant, OWRC Project No. 58-S-22.

The report offers a concise summary of operating data for the year and comparisons with previous years where these are applicable and significant.

Yours very truly,

A handwritten signature in cursive script, appearing to read "B. C. Palmer".

B. C. Palmer, P. Eng.,
Director,
Division of Plant Operations.

FOREWORD

● This operating summary contains complete information on the management of the project during 1966. It contains a concise review of the year's plant operation, significant financial details, and a visual presentation in graphs and charts of technical performance.

The information will be of value to interested parties in assessing the adequacy of the project at this time and its ability to meet future requirements.

The report is the result of co-operation by several groups within the Division of Plant Operations. These include the statistics section and the technical publications section. The Division of Finance and the draughting section of the Division of Sanitary Engineering were also closely associated with its publication.

The Regional Operations Engineer, however, has had the primary responsibility for the content, and will be happy to answer any questions regarding it.

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WATERLOO
water pollution control plant
operated for

THE CITY OF WATERLOO

by the

ONTARIO WATER RESOURCES COMMISSION

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Assistant Director:	C. W. Perry
Regional Supervisor:	D. A. McTavish
Operations Engineer:	B. W. Hansler

801 Bay Street Toronto 5

'66 REVIEW

A total of 1139.852 million gallons of sewage was treated during the year at a total cost of \$120,343.71. The operating cost per million gallons was \$105.58 and the cost per pound of BOD removed was \$0.04.

The average daily flow during 1966 of 3.12 million gallons represented an increase of 23.3 percent over the average daily flow for 1965.

Although there was a marked decrease in raw sewage BOD and suspended solids concentrations, the design values were exceeded a large part of the time. There was a corresponding improvement in the effluent although the average concentrations exceeded the OWRC objectives much of the time.

During the latter part of the year, an extended field trial of polyelectrolytes for vacuum filter sludge conditioning was run, using chemicals supplied by Dow Chemicals.

PROJECT COSTS

STAGE 1

NET CAPITAL COST (Final)	
Long Term Debt to OWRC	<u>\$728,675.93</u>
Debt Retirement Balance at Credit (Sinking Fund) December 31, 1966	<u>\$183,618.95</u>
Net Operating	\$120,343.71
Debt Retirement	26,436.00
Reserve	4,990.77
Interest Charged	40,997.04
TOTAL	<u>\$192,767.52</u>

RESERVE ACCOUNT

Balance at January 1, 1966	\$ 24,004.55
Deposited by Municipality	4,990.77
Interest Earned	<u>1,328.93</u>
	\$ 30,324.25
Less Expenditures	<u>7,407.25</u>
Balance at December 31, 1966	<u>\$ 22,917.00</u>

STAGE 2

NET CAPITAL COST (Final)
Long Term Debt to OWRC

\$13,226.41

Debt Retirement Balance at Credit
(Sinking Fund) December 31, 1966

\$ 2,434.18

Net Operating

\$ NIL

Debt Retirement

552.00

Reserve

149.13

Interest Charged

744.14

TOTAL

\$ 1,445.27

RESERVE ACCOUNT

Balance at January 1, 1966

\$ 540.89

Deposited by Municipality

149.13

Interest Earned

33.70

\$ 723.72

Less Expenditures

-

Balance at December 31, 1966

\$ 723.72

MONTHLY OPERATING COSTS

MONTH	TOTAL EXPENDITURE	PAYROLL	CASUAL PAYROLL	FUEL	POWER	CHEMICAL	GENERAL SUPPLIES	EQUIPMENT	REPAIRS & MAINTENANCE	* SUNDRY
JAN	5944.83	3180.37				261.11	90.93		2387.01	25.41
FEB	8174.26	2914.19		371.07	1864.51	262.42	67.98	37.95	99.85	2556.29
MARCH	4323.01	2945.26		249.37	1794.31		460.08	241.41	(2172.64)	805.22
APRIL	13803.35	5383.31		251.66	1881.85	4141.57	89.93	375.15	217.81	1462.07
MAY	9497.27	3255.63	207.62	98.90	1882.29	1176.00	338.71	133.10	524.88	1880.14
JUNE	15297.92	3623.28	189.58	208.76	2025.19	869.27	375.30	34.27	161.32	7810.95
JULY	10306.57	3275.84	266.96		1977.35	1294.77	238.59	82.42	762.55	2408.09
AUG	10463.80	3634.74	281.30		1825.48	1423.96	224.23	74.49	112.06	2887.54
SEPT	9597.69	5262.00	371.36		2340.98	547.58	213.65	22.56	427.81	411.75
OCT	11250.61	3355.96			1710.25		198.23	98.16	395.36	5492.65
NOV	9217.02	3378.69		175.20	2069.55	152.11	199.41		306.50	2935.56
DEC	12467.38	3308.96		521.40	4380.17	1227.66	375.27	200.00	377.33	2076.59
TOTAL	120343.71	43518.23	1316.82	1876.36	23751.93	11356.45	2872.31	1299.51	3599.84	30752.26

* SUNDRY INCLUDES SLUDGE HAULING COSTS WHICH WERE \$23,612.06
BRACKETS INDICATE CREDIT

YEARLY OPERATING COSTS

YEAR	M.G. TREATED	TOTAL COST	COST PER FAMILY PER YEAR	COST PER MILLION GALLONS	COST PER L.B. OF BOD REMOVED
1961	599,373	\$ 80710.00	\$14.20	\$134.25	-
1962	736,953	\$ 86412.00	\$15.17	\$117.30	2 CENTS
1963	762,446	\$ 96410.00	\$15.87	\$126.45	2 CENTS
1964	852,937	\$ 112363.00	\$18.72	\$131.74	2 CENTS
1965	924,094	\$ 140427.32	\$21.49	\$151.96	4 CENTS
1966	1139,852	\$ 120343.71	\$16.81	\$105.58	4 CENTS

* BASED ON ANNUAL POPULATION ESTIMATE AND 3.9 PERSONS PER FAMILY

VACUUM FILTER COSTS (MONTHLY)

MONTH	COST PER MONTH					TOTAL	COST PER TON DRY WEIGHT					TOTAL
	FeCl ₃	LIME	LABOUR	ELEC	MAINT		FeCl ₃	LIME	LABOUR	ELEC	MAINT	
JANUARY	251.53	130.38	246.84	57.43	60.84	747.02	4.38	2.27	4.30	1.00	1.06	13.01
FEBRUARY	117.79	63.45	120.52	27.35	29.92	359.03	4.31	2.32	4.41	1.00	1.09	13.13
MARCH	251.47	172.38	302.02	87.22	73.80	886.89	2.88	1.98	3.46	1.00	0.85	10.17
APRIL	144.26	125.12	175.69	53.34	42.88	541.29	2.71	2.35	3.29	1.00	0.80	10.15
MAY	512.93	393.75	611.29	141.05	150.59	1809.61	3.64	2.79	4.33	1.00	1.07	12.83
JUNE	166.84	112.88	175.69	33.91	42.88	532.20	4.92	3.33	5.18	1.00	1.26	15.69
JULY	92.67	68.25	95.83	17.91	23.94	299.60	5.17	3.81	5.35	1.00	1.34	16.67
AUGUST	248.22	171.50	268.62	58.75	65.82	812.91	4.23	2.91	4.57	1.00	1.12	13.83
SEPTEMBER	409.80	269.95	439.50	95.34	107.71	1321.30	4.30	2.83	4.60	1.00	1.13	13.86
OCTOBER	*118.96	*56.45	297.66	73.60	72.80	1017.10	*4.98	*2.36	4.04	1.00	0.99	13.82
NOVEMBER	**	**	768.11	184.21	188.49	2614.49	**	**	4.17	1.00	1.02	14.19
DECEMBER	**	**	559.02	114.48	137.63	1726.99	**	**	4.88	1.00	1.20	15.09
TOTAL	2314.47	1564.11	4059.79	944.59	997.30	12677.43	41.52	26.95	52.58	12.00	12.93	162.44
AVERAGE PER MONTH	257.16	173.79	338.32	78.72	83.11	1055.61	4.15	2.99	4.38	1.00	1.08	13.54

* FIVE DAYS' USE OF FeCl₃ AND CaO ONLY

** POLYELECTROLYTE USED. COST

PER MONTH

PER TON D.S.

OCTOBER \$ 397.63

\$8.00

NOVEMBER \$1473.68

\$8.00

DECEMBER \$ 915.86

\$8.00

MONTHLY TOTALS INCLUDE POLYELECTROLYTE.

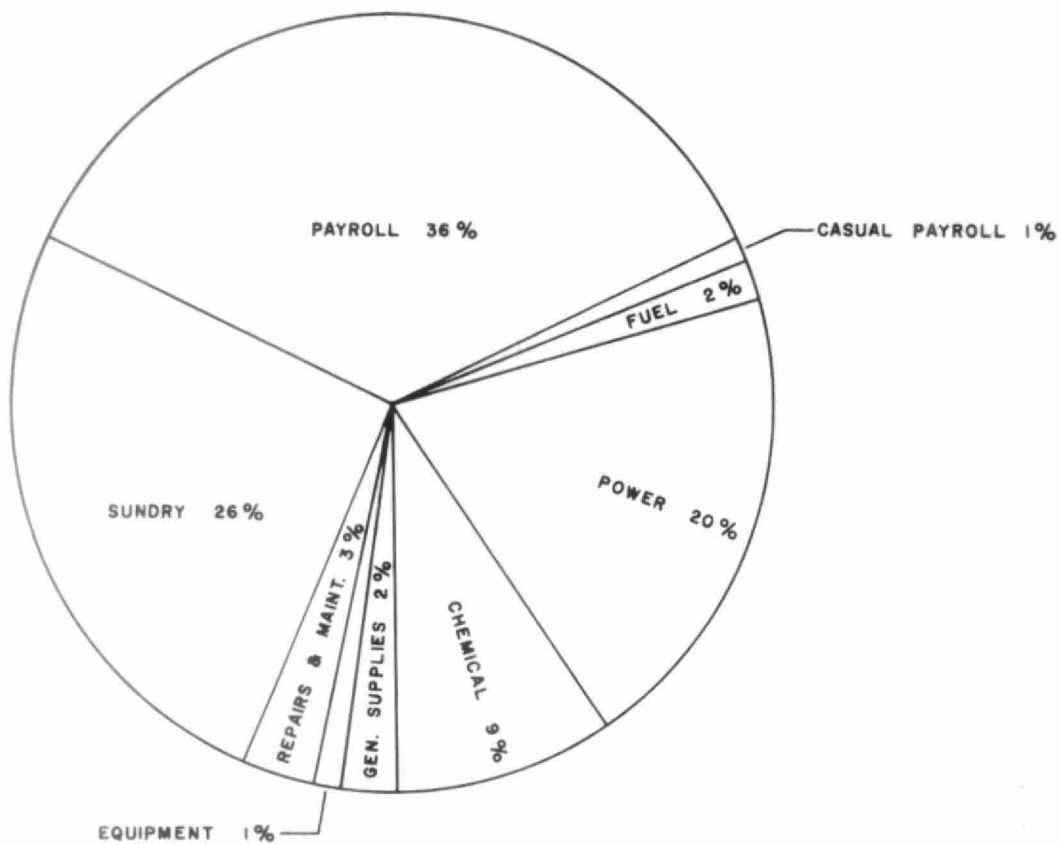
COMMENTS

Using ferric chloride and lime as conditioning chemicals, 596.274 tons of dry solids were filtered producing 81,140 cubic feet of filtered sludge. The cost of haulage for this sludge was \$2780 or \$4.66 per ton of dry solids filtered.

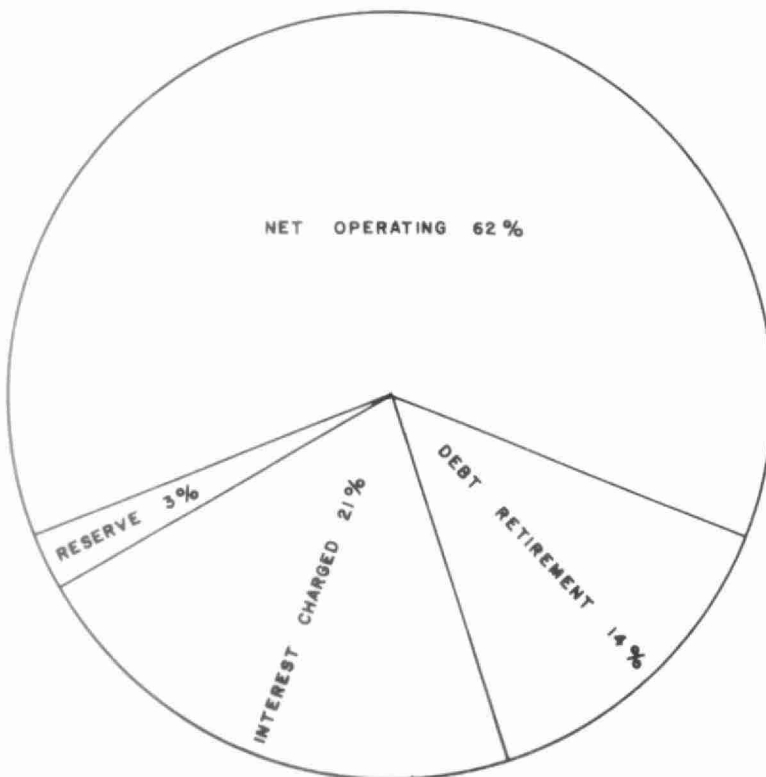
With polyelectrolytes, 348.397 tons of dry solids were filtered, producing 43,400 cubic feet of filtered sludge. The cost of haulage was \$1480 or \$4.24 per ton of dry solids filtered.

The cost of operating the vacuum filter using ferric chloride and lime as sludge conditioning chemicals averaged \$13.22 per ton of dry solids; whereas the average cost, using polyelectrolytes, was \$14.37 per ton of dry solids. The overall cost of sludge removal using ferric chloride and lime averaged \$17.88 per ton of dry solids compared to \$18.61 using polyelectrolytes.

1966 OPERATING COSTS



TOTAL ANNUAL COST



Process Data

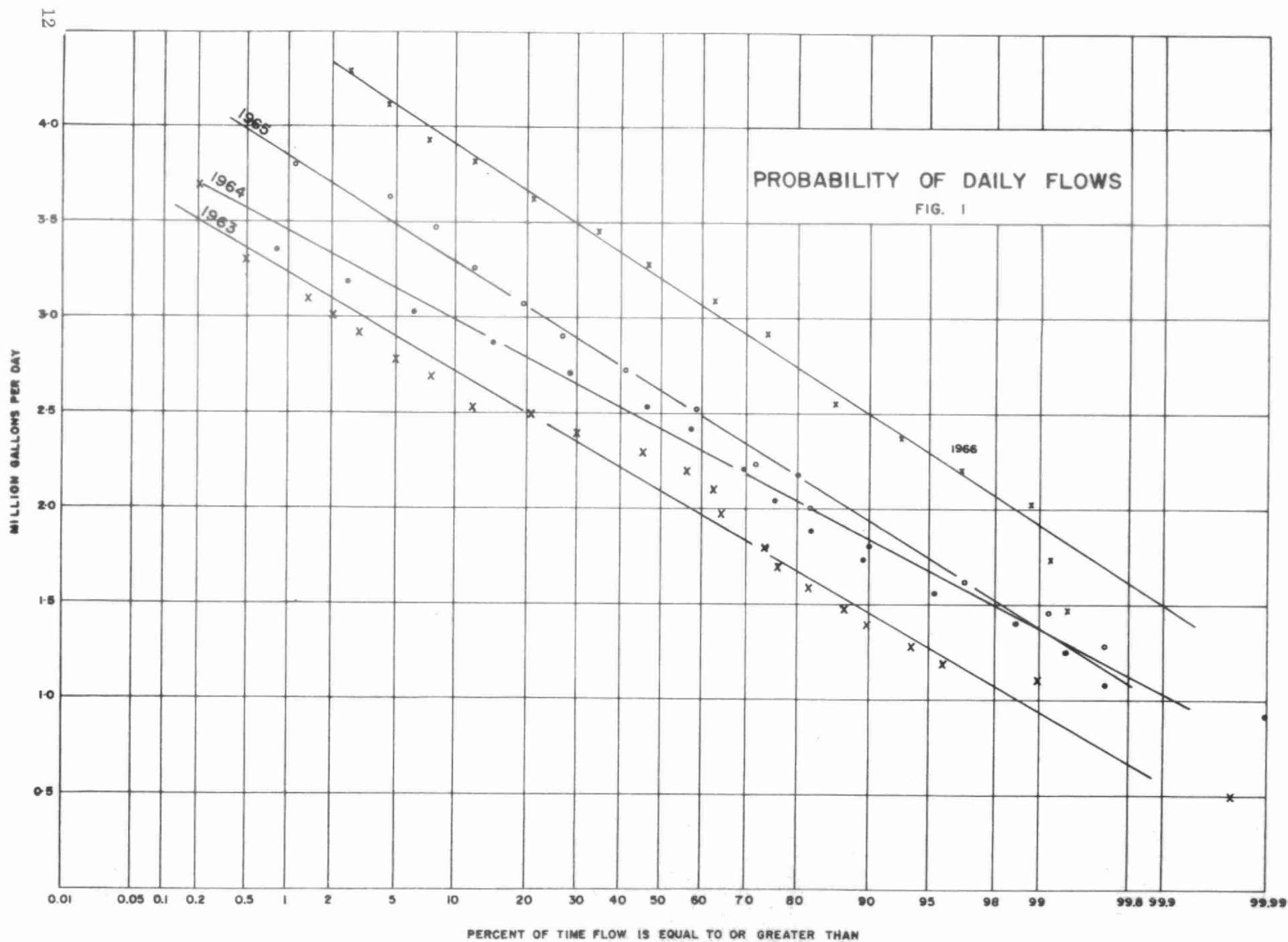
The average daily flow (Fig. 2) of 3.12 million gallons represents an increase of 23.3 percent over the average flow recorded in 1965. The minimum average daily flow for the month of 2.69 million gallons occurred in February; the maximum of 3.74 million gallons, in December.

From Fig. 1, it can be seen that the plant design flow of 4.0 was exceeded seven percent of the time.

The BOD concentrations are plotted on a probability basis and a monthly average basis in Figs. 3 and 5. The design raw sewage BOD concentration of 300 ppm was exceeded 61 percent of the time. Fig. 5 shows a trend to decreased BOD concentrations in the raw sewage. The raw sewage BOD concentration averaged 306 ppm for the year. It can be shown that the average BOD loading was 9,550 pounds per day, 79.5 percent of design loading.

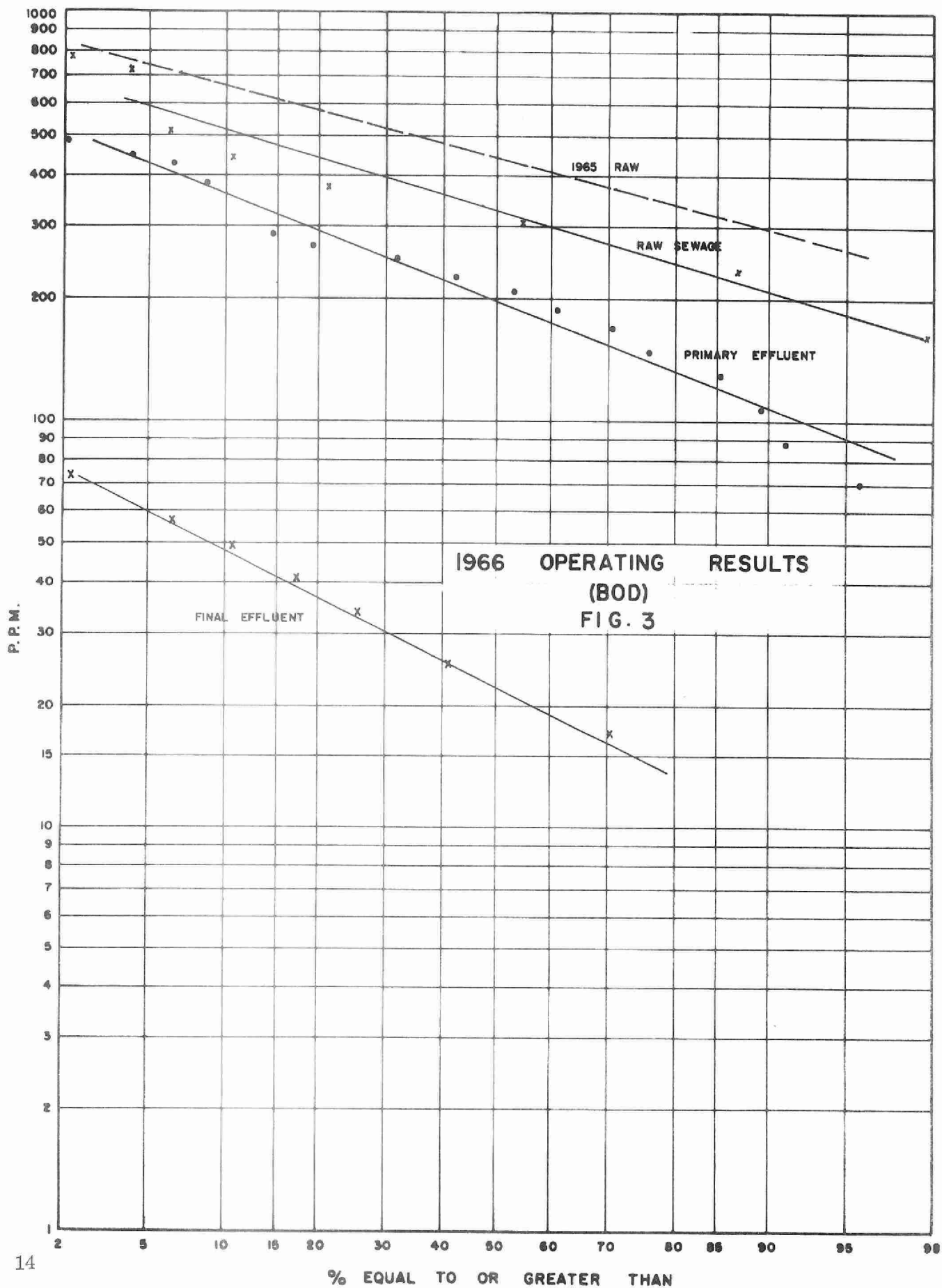
The suspended solids concentrations are plotted on a probability and monthly average basis in Figs. 4 and 6. The design raw sewage suspended solids concentration of 270 ppm was exceeded 41 percent of the time. Fig. 6 shows a trend to decreased suspended solids concentrations in the raw sewage, corresponding to the reduction in raw sewage BOD. The raw sewage suspended solids averaged 257 ppm contributing a loading of 8,000 pounds per day, 74 percent of the design value.

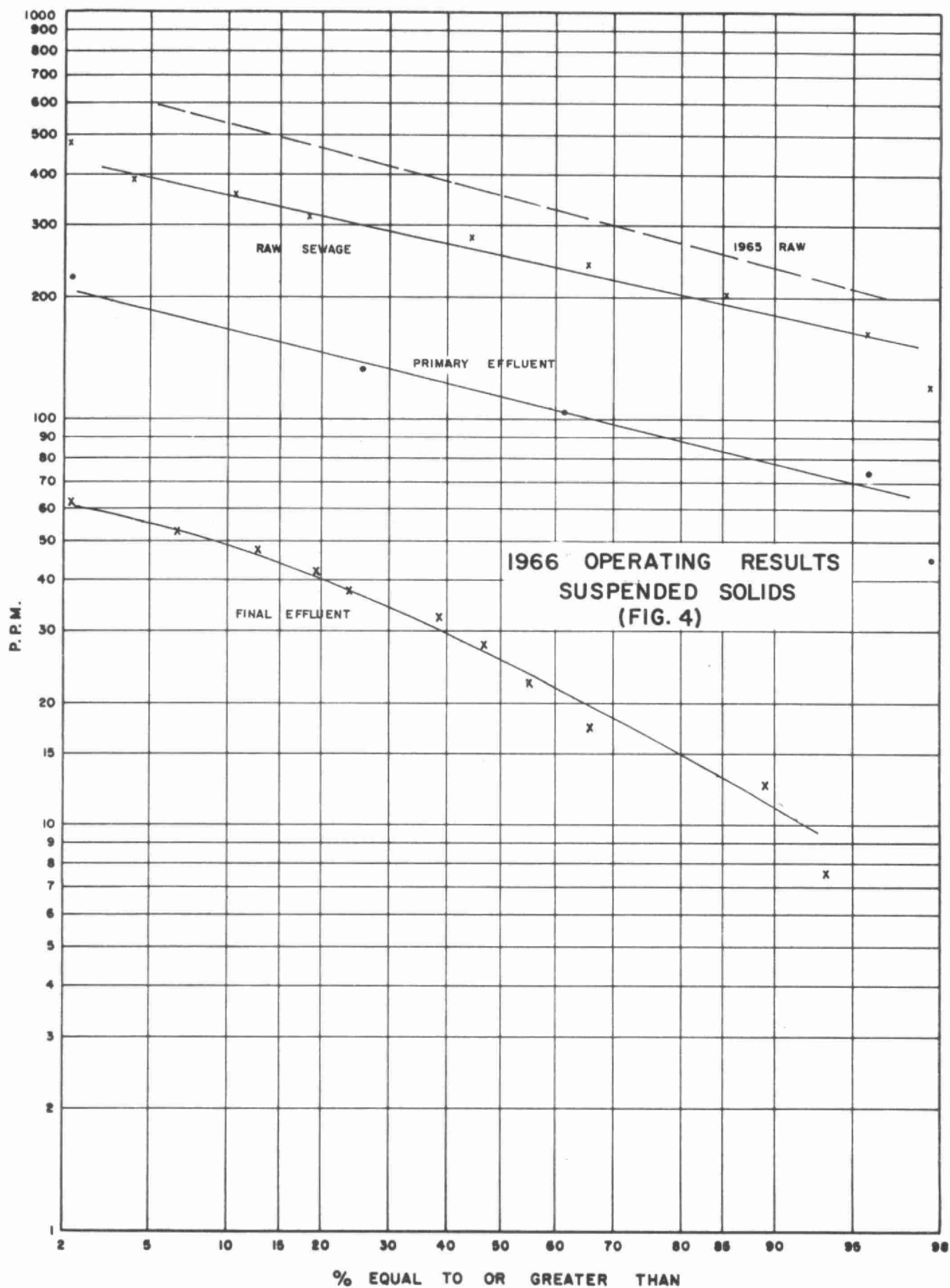
The plant effluent BOD and suspended solids concentrations exceeded the OWRC objectives of 15 ppm for each 74 percent and 79 percent of the time respectively. The average effluent BOD concentration during the year was 24 ppm; the suspended solids concentration, 27 ppm.

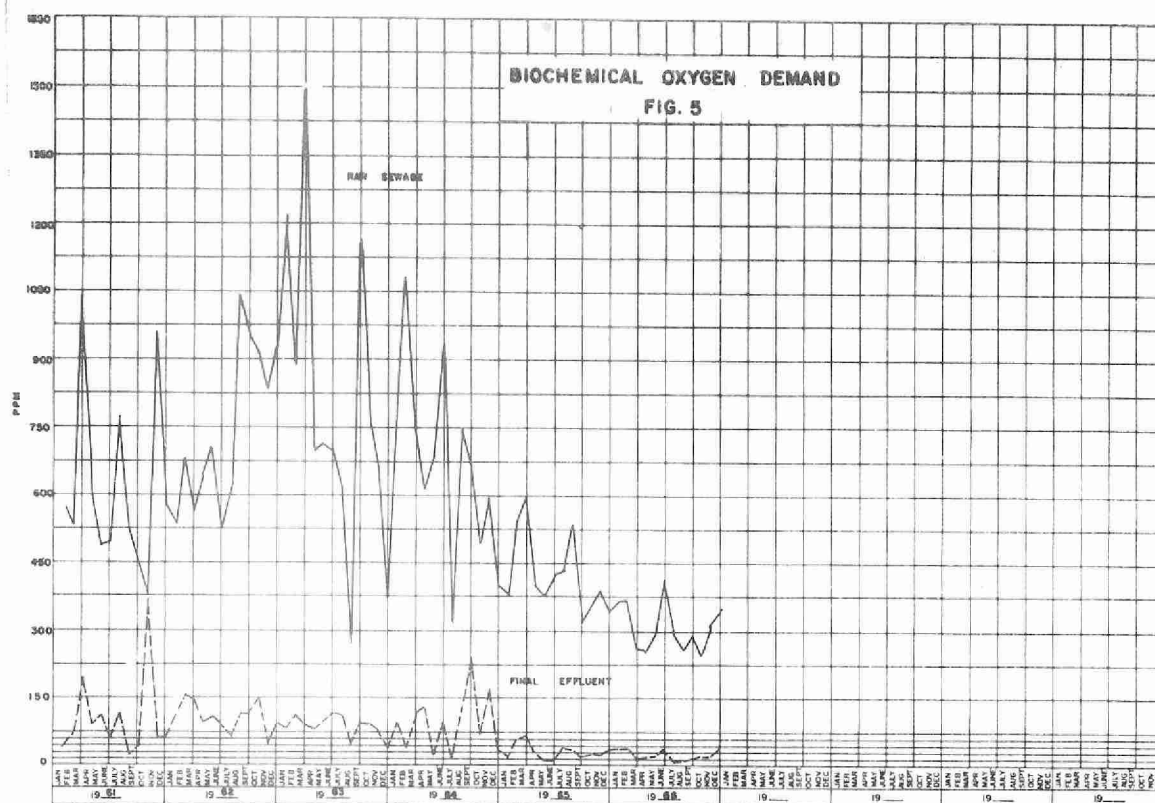


AVERAGE DAILY FLOW
FIG. 2

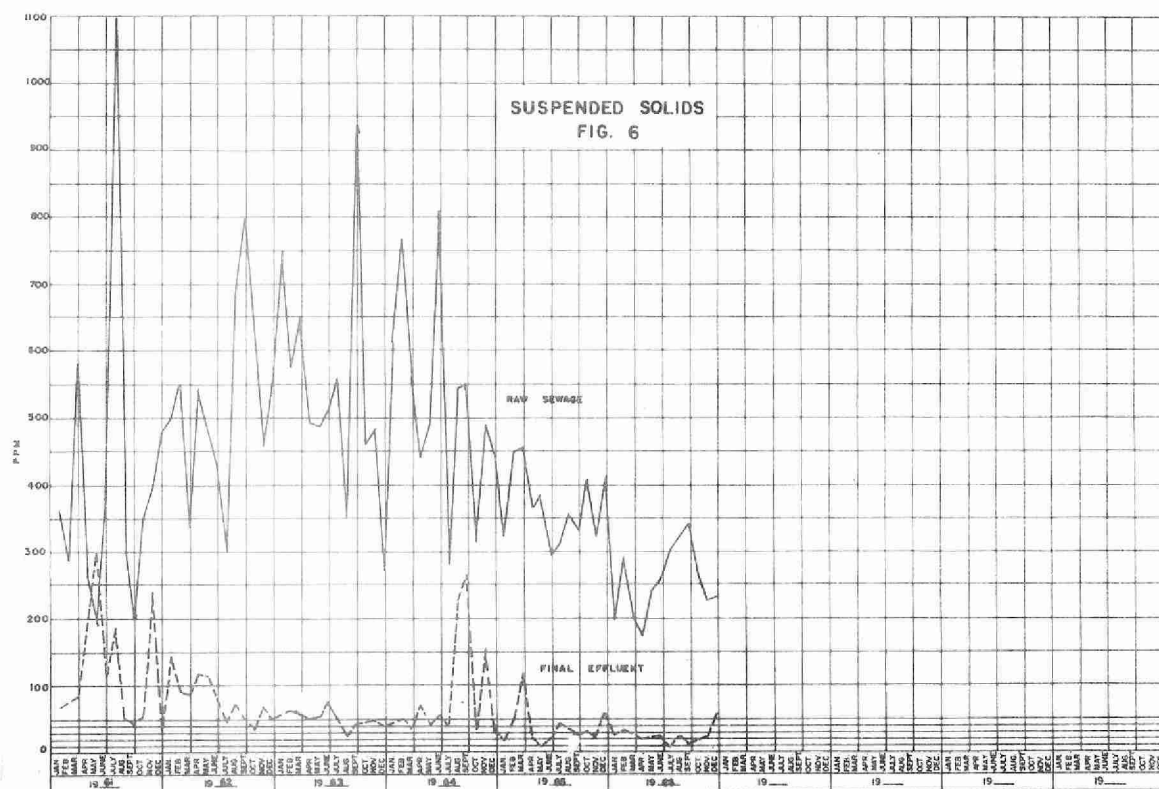








MONTHLY VARIATIONS



GRIT, B.O.D AND S. S. REMOVAL

MONTH	B. O. D.				S. S.				GRIT REMOVAL CU. FT.
	INFLUENT PPM.	EFFLUENT PPM.	% REDUCTION	TONS REMOVED	INFLUENT PPM.	EFFLUENT PPM.	% REDUCTION	TONS REMOVED	
JAN.	362	38	89.5	141.0	199	30	85.0	73.5	88.5
FEB.	367	38	89.5	122.5	293	35	88.0	96.0	580.0
MAR.	264	19	93.0	116.2	205	29	86.0	83.5	135.0
APR.	255	20	92.0	113.6	176	21	88.0	74.9	98.0
MAY	292	22	92.5	134.0	241	27	89.0	106.2	186.0
JUNE	404	36	91.0	185.2	260	27	89.5	117.3	77.0
JULY	294	11	96.5	124.4	304	11	96.5	128.8	45.5
AUG.	260	13	95.0	114.2	326	26	92.0	138.6	65.5
SEPT.	287	15	94.5	120.0	347	14	96.0	146.9	52.0
OCT.	244	20	92.0	104.3	272	23	91.5	115.9	84.5
NOV.	303	22	92.5	152.0	229	22	90.5	112.0	180.0
DEC.	340	34	90.0	177.4	232	55	76.5	102.6	133.5
TOTAL	-	-	-	1607.2	-	-	-	1310.8	1725.5
AVG.	306	24	92.0	133.9	257	27	89.5	109.2	143.8

COMMENTS

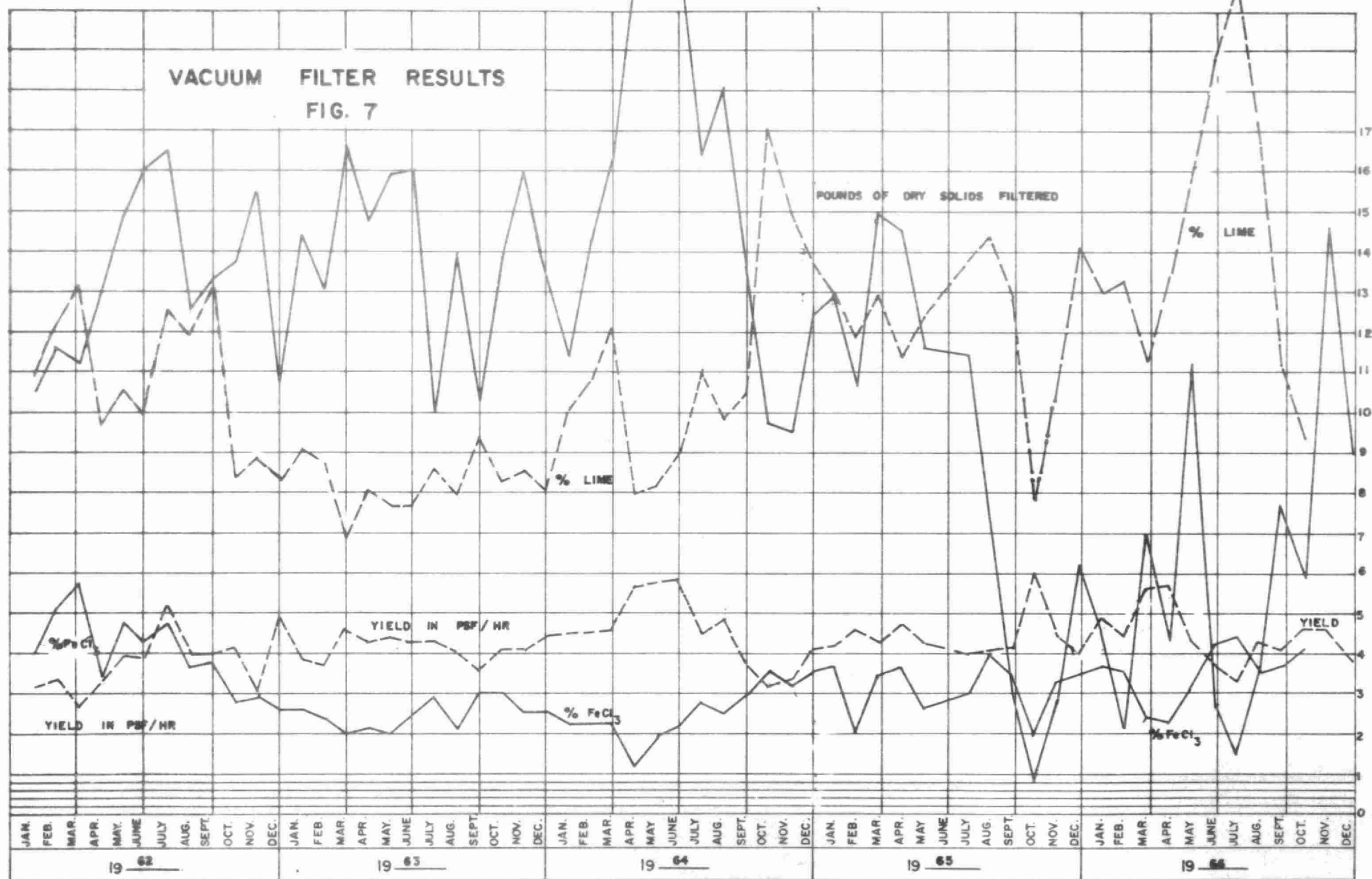
The BOD and suspended solids concentrations were based on laboratory analyses of eight-hour composite samples collected at weekly intervals.

The average raw sewage BOD concentration of 306 ppm approximated the design value of 300 ppm and represented 72 percent of the BOD concentration in raw sewage received in 1965. The average plant effluent BOD concentration of 24 ppm was greater than the OWRC objective of 15 ppm, but was a significant improvement over the average of 32 ppm recorded in 1965. The average BOD reduction during 1966 was 92.0 percent.

The average raw sewage suspended solids concentration of 257 ppm was slightly less than the design value of 270 ppm. The reduction in raw sewage suspended solids concentration in 1966 was reflected in the improved effluent. The plant effluent suspended solids concentration of 27 ppm, while greater than the OWRC objective of 15 ppm, was a marked improvement over the average of 40 ppm for 1965. The average suspended solids reduction was 89.5 percent.

A total of 1725.5 cubic feet of grit was removed during the year. This represents 1.5

VACUUM FILTER RESULTS FIG. 7



VACUUM FILTER OPERATION

MONTH	FILTER HOURS		% SOLIDS DIGEST SLUDGE	LBS. DRY SOLIDS FILTERED	LBS. LIME	% LIME	LBS. FeCl ₃	% FeCl ₃	% SOLIDS FILTERED SLUDGE	YIELD PSF/HOUR
	# ₁	# ₂								
JAN.	85.0	-	6.00	114858	10430	9.1	4256	3.7	20.4	4.96
FEB.	41.5	-	5.36	54700	5075	9.3	1993	3.6	19.6	4.40
MAR.	104.0	-	7.20	174435	13790	7.9	4255	2.4	23.8	5.60
APR.	60.5	-	6.30	106867	10010	9.4	2441	2.3	21.3	5.70
MAY.	210.5	-	5.70	282094	31500	11.2	8679	3.1	18.4	4.37
JUNE	60.5	-	4.60	67813	9030	13.3	2823	4.2	19.7	3.70
JULY	33.0	-	4.05	35824	5460	15.2	1568	4.4	19.4	3.30
AUG.	92.5	-	4.90	117491	13720	11.7	4200	3.6	19.4	4.31
SEPT.	151.0	-	4.80	190670	21595	11.3	6934	3.7	17.9	4.10
OCT. 1-7 24-31	38.0	-	5.14	47796	4515	9.4	2013	4.1	18.8	4.10
	64.5	-	5.70	99409	* 1958	-	-	-	16.0	5.10
NOV.	264.5	-	5.40	368419	* 7414	-	-	-	15.5	4.60
DEC.	192.5	-	4.70	228965	* 5660	-	-	-	15.8	3.90
TOTAL	1398.0	-	-	1889341	125125	-	39162	-	-	-
AVG.	116.5	-	5.37	157445	13903	10.5	4351	3.3	19.0	4.46

* Polyelectrolyte (lbs.) used in lieu of CaO and FeCl₃

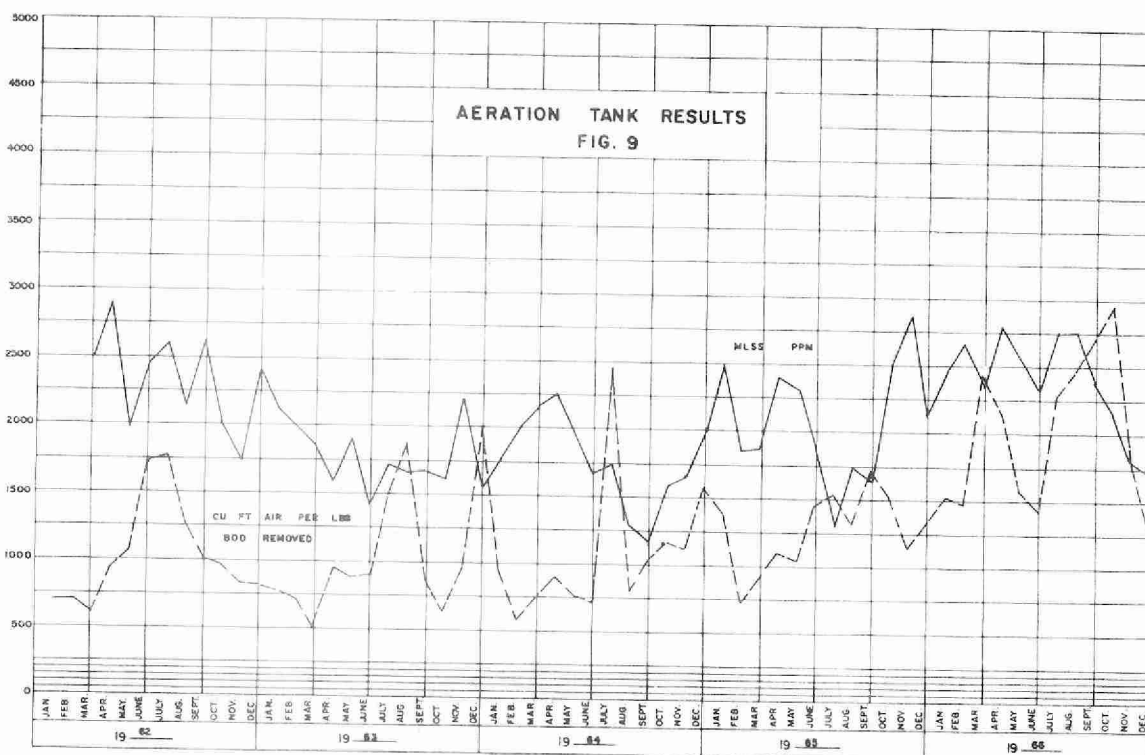
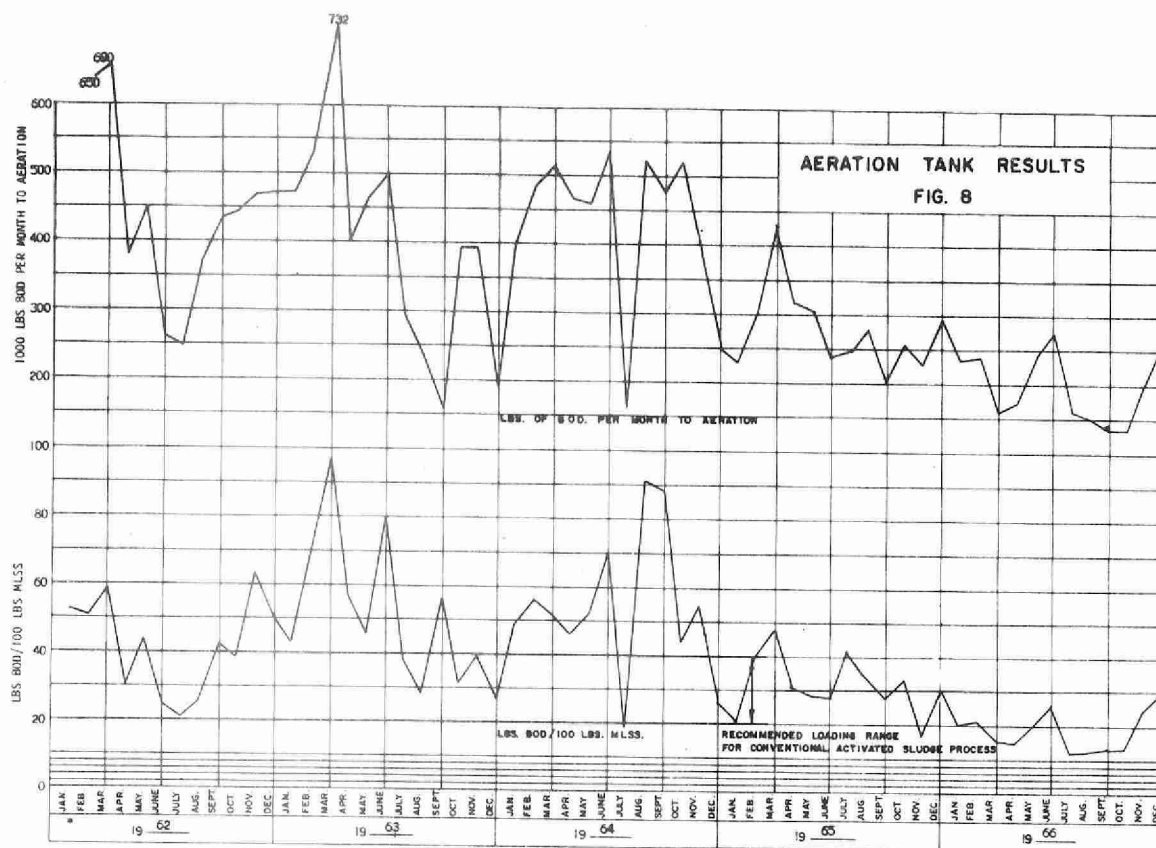
** Lime is expressed as 100% CaO

COMMENTS

During 1966, the filter was operated an average of 116.5 hours per month. As shown in the table, the vacuum filter reduced the moisture content of the sludge from 94.63 percent to 81.0 percent, which represents a reduction in volume of 71.7 percent.

The average filter yield of 4.46 pounds per square foot per hour is comparable to other plants filtering raw and waste activated sludge.

It can be seen from the table that the filter cake using ferric chloride and lime was drier than that for the polyelectrolyte. The average total solids of the filtered sludge were 19.9 percent and 15.8 percent respectively. There was no significant difference in yield. 341,210 cubic feet of raw sludge were filtered using ferric chloride and lime, 219,190 cubic feet with polyelectrolytes.



AERATION SECTION

MONTH	PRIM. EFFL. B.O.D. PPM.	MLSS. PPM.	LBS. BOD. PER 100 LBS. M. L. S. S.	CUBIC FEET AIR PER LB. BOD. REMOVED
JANUARY	271	2480	20	1533
FEBRUARY	323	2684	21	1482
MARCH	170	2369	15	2431
APRIL	182	2824	14	2152
MAY	245	2595	20	1573
JUNE	270	2343	26	1430
JULY	183	2772	12	2302
AUGUST	164	2791	12	2494
SEPTEMBER	155	2417	13	2728
OCTOBER	145	2174	13	2991
NOVEMBER	195	1830	25	1800
DECEMBER	270	1736	39	1272
TOTAL	-	-	-	-
AVERAGE	214	2418	19	2016

COMMENTS

The primary effluent BOD concentration of 214 ppm for 1966 represents a decrease of 41.8 percent from 1965. The average loading on the aeration section of 19 pounds of BOD per 100 pounds of MLSS is within the acceptable range for a conventional activated sludge process.

There was an increase of 57 percent in the air supplied per pound of BOD removed in 1966.

SLUDGE

MONTH	PUMPAGE TO COIL FILTER	FILTER CAKE PRODUCED	LIQUID SLUDGE
(in thousands of cubic feet)			
January	31.24	7.64	43.90
February	16.60	3.89	24.95
March	39.03	10.77	25.27
April	26.21	5.53	12.47
May	77.98	20.79	56.05
June	23.61	6.59	100.76
July	13.29	3.13	45.20
August	38.40	8.45	63.99
September	61.85	13.15	57.19
October	43.08	9.23	40.99
November	109.21	24.06	42.96
December	79.90	12.58	29.32
Total	560.40	125.81	543.05
Average	46.70	10.48	45.25

COMMENTS

A total of 125,810 cubic feet of filtered sludge was removed in 1966.

There was more sludge produced than could be dewatered by vacuum filtration. The excess was removed by tank truck. The volume of liquid raw sludge removed was 543,050 cubic feet during the year.

A total of 1,103,450 cubic feet of liquid sludge was produced during 1966. This represents a reduction of 21 percent from the 1,395,700 cubic feet in 1965.

During the last three months of the year, polyelectrolytes were used in vacuum filtration. The filtered sludge produced during the first nine months was 81,410 cubic feet and during the last three months, 43,400 cubic feet.

CHLORINATION

MONTH	PLANT FLOW (MG)	POUNDS CHLORINE	DOSAGE RATE (PPM)
JANUARY	87.012	6120	7.03
FEBRUARY	75.460	* 2790	7.39
MARCH	94.858	5755	6.07
APRIL	96.655	5595	5.79
MAY	99.278	6504	6.55
JUNE	100.682	6120	6.08
JULY	87.939	4575	5.20
AUGUST	92.438	4110	4.45
SEPTEMBER	88.241	4105	4.65
OCTOBER	93.130	4210	4.52
NOVEMBER	108.189	4665	4.31
DECEMBER	115.970	5005	4.32
TOTAL	1139.852	59554	-
AVERAGE	94.988	4963	5.40

* 14 days' chlorination. Mechanical failure

COMMENTS

The average chlorine dosage rate of 5.40 ppm was sufficient to maintain a residual of 0.5 ppm after a 15-minute contact period. This represents a 23.5 percent decrease in dosage rate from the previous year and can be attributed to the lower organic loads received at the plant.

Date Due

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CONCLUSIONS

The plant produced an improved effluent during the year due to the reduced organic loading. Plant enlargement is planned for 1967.

